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Radicular Pain in the Upper Extremity

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THE problem of radicular or root pain continues to intrigue practitioners of medicine. It is of particular importance to the internist, the orthopedist, the neurologist and the neurosurgeon. With the knowledge that has accumulated in the past 13 years about syndromes due to abnormal states of the intervertebral discs,[4] root pain has evoked new interest and concern. The contribution of Semmes and Murphey[6] concerning unilateral rupture of the cervical intervertebral discs served to focus attention on a group of cases that have proved difficult to manage, and afforded explanations of certain clinical phenomena that had previously been subjects for widespread differences of opinion.

Many questions remain to be answered, however, about certain syndromes of which radicular pain in the upper limbs is an essential presenting symptom. There are those cases of pain in the shoulder, arm, or forearm, in which thorough studies reveal no objective evidences of disease; cases with lesions of the tendon cuff of the shoulder in which, in addition to pain in the shoulder and arm, there is root pain in the lower posterior cervical region and forearm, with or without paresthesias such as numbness or tingling in the tips of the thumb and fingers; cases in which there are abnormal roentgenologic or neurologic findings in conjunction with root pain which resolves satisfactorily after conservative treatment; and finally, cases in which demonstrable protrusion of nuclear material from a disc occurs. It is to cases of these sorts that this paper is devoted.

ANATOMICAL CONSIDERATIONS

The bodies of the cervical vertebrae differ in certain respects from the others. Instead of being cylindrical in shape they are oblong, the transverse diameter being much longer than the anteroposterior. The pedicles or roots of the vertebral arches spring from the posterior half of the lateral aspects of the body, extend posteriorly and fuse with the laminae which converge posteriorly to enclose the vertebral canal. Binding together the laminae of the adjoining vertebrae are the ligamenta flava.

The vertebral canal is larger than in the thoracic or lumbar region, and is triangular or more nearly semilunar in outline. Where the pedicles and laminae join, cylindrical masses of bone project upward and downward to support the superior and inferior articular processes. The bone is so sliced away that the superior articular facets are directed upward and backward and the corresponding inferior surfaces are turned downward and forward. The apophyseal joints which are formed in this way are provided with complete but very thin-walled articular capsules lined with synovia. Corresponding to the freedom of movement of the neck, these capsules are thinnest and loosest in the cervical region.

Lying between the bodies of the vertebrae are the intervertebral fibrocartilages or discs. In the region between the third and seventh cervical vertebrae they are thinner than in any other portion of the spine. The superior and inferior surfaces of the discs are closely adherent to the epiphyseal plates of the adjoining vertebrae. The circumferential portion or annulus fibrosus, formed chiefly of parallel fibers running from one vertebra to the other, completely encloses the nucleus pulposus, which is composed of the remnant cells from the notocord and a semigelatinous matrix containing 75 to 90 per cent water.[1]

Each nerve root emerges from an intervertebral foramen which is bounded anteriorly by an intervertebral disc and by the bodies of the adjoining vertebrae, posteriorly by the capsules surrounding the intervertebral joints and above and below by the inferior and superior notched borders of the pedicles.

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CLINICAL CONSIDERATIONS

Radicular pain arises from irritation of a sensory or posterior nerve root. The sensory root extends from the pia mater of the spinal cord to the outer aspect of the corresponding intervertebral canal, the spinal ganglion lying in the foramen. The roots of the nerves may be involved in the subarachnoid space or in the intervertebral canal. While both the motor and sensory roots are usually involved, sensory symptoms are more common and conspicuous, the constant feature being pain.[8] In turn, the swelling which often accompanies or follows compression of the nerve tends to aggravate and perpetuate the initial symptoms. It must be emphasized that the sensory fibers derived from a single posterior nerve root are not the exclusive source of innervation to any region, and that the sensory distribution of any given nerve root does not conform to that of any peripheral nerve since peripheral nerves are composed of fibers derived from two or more nerve roots.

From these data it is apparent that pathologic conditions of the body or pedicles of a vertebra, or the overlying periosteum, arthritic changes in an intervertebral articulation, rupture of an annulus fibrosus of an intervertebral disc, with or without extrusion of the nucleus pulposus, and disease of the ligaments may result in the development of syndromes characterized in great part by radicular pain.

CASE REPORT

CASE 1. While playing golf, a 43-year-old man suddenly noted a pain in the upper part of the right interscapular area which became more pronounced the next day and was not relieved by osteopathic adjustment. The pain radiated down the lateral aspect of the right arm and forearm to a level a short distance above the wrist. It was an agonizing, constant, dull ache, worse in the evening, less bothersome while he was at work, and relieved by walking. Within a day or two after the onset of pain, numbness developed in the terminal phalanges of the second and third digits of the right hand.

On the fourth day of the illness there was restricted motion of the neck. The pain had begun to be aggravated by extension of the head and neck. Roentgenograms of the cervical portion of the spine revealed slight hypertrophic osteoarthritic changes anteriorly along the lower margin of the fifth cervical vertebral body. On the tenth day the patient was admitted to the hospital after physical therapy had not relieved his discomfort. On the eleventh day the pain was so severe that he repeatedly left the bed and paced the floor for relief.

A neurologic examination made the following day was negative. On the assumption that the underlying pathologic process involved the periosteum and the apophyseal joints and ligaments adjoining the right intervertebral foramen between the fifth and sixth cervical vertebrae, absolute rest in bed and traction were instituted. Fairly prompt relief followed.

CASE REPORT

CASE 2. In November, 1943, a married woman 49 years of age began to suffer from "terrific pain" in the left shoulder that awakened her from sleep almost nightly for the ensuing three or four months. The pain, which was of aching character, radiated from the shoulder to the lower posterior cervical region, over the scapula and down the lateral aspect of the arm to the elbow, and later into the radial half of the forearm. Cold damp weather and especially motion of the joint aggravated the pain. About a month afterward numbness appeared in the distal phalanges of the second and third fingers. Toward the middle of February, 1944, the patient became unable to button her clothes in the back with her left hand.

The left arm was carried by the side. Moderate limitation of the shoulder, particularly in abduction and external rotation, was noted, with slight atrophy of the musculature of the left scapula and shoulder. There was point tenderness over the anterolateral aspect of the shoulder. The tendinous reflexes of the upper and lower limbs were elicited with some difficulty but were equal on the two sides. No impairment of common or deep sensation could be demonstrated. There was no limitation of motion of the neck nor tenderness over the cervical portion of the spine. Roentgenograms of the cervical spine and of the left shoulder were negative. Physical therapy, including heat, massage and passive movement, was initiated on February 25, 1944. At that time the patient began a program of daily exercises which has been continued to the present. Within a short time the pain began to diminish gradually in severity. The paresthesias left by degrees. By May 5, 1944, the pain had markedly diminished. Abduction of the left shoulder was possible to the extent of 75 degrees. Anteriorly the arm could be raised to 90 degrees. With difficulty the patient could reach the back of her neck and waist. After an operation for fistula in ano, in September, 1944, the pain left. On December 5, 1944, there was still slight limitation of abduction and external rotation of the left shoulder. Roentgenograms of the cervical spine made in April, 1947, show hyperthrophic spurs of moderate size along the posterior borders of the bodies abutting on the fourth and fifth, and fifth and sixth intervertebral spaces. Roentgenograms of the shoulder are negative.

DISCUSSION

The first case is one of osteoarthritis of the cervical spine in which the symptoms of radicular pain and paresthesias are due to changes in the soft tissues contiguous to the right sixth cervical nerve root in the intervertebral foramen lying between the fifth and sixth cervical vertebrae. The second case is a fairly typical one of supraspinatous tendonitis of non-calcific type, or what was formerly described as subacromial or subdeltoid bursitis. It is an entity that usually begins in middle age, may come on acutely, generally with pain in the shoulder and limitation of motion, especially in abduction and external rotation. The pain may radiate into the arm and forearm and to the trapezius area. At times it may be associated with paresthesias of the fingers. On examination there is generally point tenderness over the insertion of the supraspinatous tendon. Almost invariably the pain is induced on attempted abduction or external rotation. Later, atrophy of the deltoid may give the shoulder an appearance of squareness. Calcium deposits in the tendon or bursa or both more frequently appear in cases of a recurring character. Sometimes they are observed during the first acute episode. In this instance the obvious pathologic change was in the shoulder, where three and one-half years after onset there is still limitation of motion.

Lesions limited strictly to the shoulder, however, rarely induce pain that radiates below the level of the elbow. Paresthesias in the fingers are not susceptible of explanation on the basis of a lesion of

the shoulder alone. The combination of radicular pain and paresthesias in the fingertips strongly suggests that a part of the syndrome arises from pressure of swollen tissues on a nerve root in an intervertebral foramen. It seems probable that transient swelling of the apophyseal joints, the periosteum and the adjacent ligaments may occur, roentgenographic evidence of which may not appear, as in this instance, for years afterward. The evolution of a typical Heberden's node appears to offer an analogous picture. Roentgenograms of the small red raised tender masses that are seen at the distal interphalangeal joints of a finger as the first manifestation of this type of trouble are negative. Later, when the acute inflammatory reaction has subsided, hypertrophic spurs or lipping may be demonstrated by x-ray. Cases of this sort have led to the assumption that in some instances the condition in the region of the shoulder is secondary to that of the spine, and possibly of trophic origin.[2]

CASE REPORT

CASE 3. A married woman 41 years of age, who had been in good health, was examined in the hospital December 30, 1938. In August she had begun to be awakened two or three times nightly by tingling in the tips of the fingers of the left hand, which "could be rubbed away." Two or three weeks later, on awakening during the night, she became aware of pain in the left suprascapular region which radiated to the left shoulder and arm. At first it would leave promptly when the patient arose and became active. Gradually it grew worse. By the end of ten days the pain was constant almost day and night and wakened her repeatedly. The tingling would recur during the day upon elevation of the left upper limb, as to comb the hair. At the end of a week the pain began to diminish. Several days later the patient was free from pain and the tingling had ceased to recur.

In mid-November, however, the tingling returned in the tips of the fingers and soon spread to the entire left hand. It awakened the patient two or three times each night. At the end of the week she was awakened three or four hours after retiring by pain "in the back of the left shoulder" which radiated to the left arm and shortly afterward to the radial half of the left forearm. A fortnight later she was admitted to the hospital with very severe constant pain, particularly in the morning on first waking up. The tingling in the left hand was present most of the time. Improvement followed several days of rest and exposure to a sun lamp and the patient returned home for the Christmas holidays. On December 27, the pain became more troublesome. "A severe burning wave-like distress" set in over the volar aspect of the left arm, forearm, wrist and palm. Coincidentally, numbness of the tips of the left thumb and the distal and middle phalanges of the left index and middle fingers developed. On examination the patient was found to be in great pain. Moderate weakness of the left triceps and absence of the left triceps reflex were noted. There was no cervical rigidity and no pain on snapping the head onto the chest. Percussion over the spine induced no discomfort. Roentgenograms revealed loss of the normal cervical lordotic curve below the fourth cervical vertebra, and a slight degree of hypertrophic osteoarthritis along the posterior margins of the bodies of the sixth and seventh cervical vertebrae.

The patient was placed at absolute rest in bed and given codeine for relief of pain. On January 5, 1939, tonsillar tags were removed. By January 13, analgesic medication no longer was needed and by January 29 the patient was free from pain. The numbness in the fingers of the left hand persisted in diminishing degree for 13 or 14 months. There has been no recurrence of symptoms.

DISCUSSION

In this instance it was decided that an examination of the cerebrospinal fluid and myelographic studies would be made if the patient did not show prompt improvement. When the pain diminished and left, further investigative studies were not made. While it is possible that this syndrome was due to hypertrophic osteoarthritis, in the light of subsequent knowledge, the weakness of the left triceps and the absence of the left triceps reflex, the obliteration of the normal cervical curve in the lateral roentgenograms of the cervical spine, and the recurring attacks of radicular pain with paresthesias in the fingers strongly suggest rupture of a cervical intervertebral disc. In particular, it should be emphasized that loss of a tendon reflex in cases of this type is indicative of an abnormal state of the disc rather than of the other soft tissues. The diagnosis must ultimately rest on myelography.[2]

Tumor of the cervical portion of the spinal cord, a much rarer clinical entity, may lead to the production of a similar syndrome. In that instance, however, protracted relief would not be expected from conservative measures. Ultimately, the steady relentless progression characteristic of neoplasms would lead to symptoms of compression of the spinal cord.

This case is an example which illustrates the wisdom of a conservative approach to cases of radicular pain even with muscular weakness, loss of reflexes and obliteration of the normal cervical lordotic curve. Scoville's statement[5] that less than ten per cent require surgical treatment seems entirely sound. Only when patients have intractable or recurring pain and only after conservative measures such as absolute rest in bed and traction have proved unsuccessful, is surgical treatment advisable.

CASE REPORT

CASE 4. A man 52 years of age complained of pain and weakness in the right arm and hand. Seventeen years before, his neck had been forcibly flexed in an automobile accident and for several weeks afterward he suffered from local stiffness and soreness. While playing tennis four years before he had suddenly developed pain in the lower posterior cervical region, with extension to the right arm. Though the pain fluctuated notably in severity, it was persistent despite treatment with heat, diathermy, massage, and traction from time to time. On two occasions, the first two years before the present examination, and the second a year before, he had had periods of weakness of the right arm with a moderate degree of wrist drop. The first episode cleared up after traction; the second was followed by atrophy of the musculature of the entire right upper limb which was most marked in the forearm. During the three months preceding examination he had suffered most of the time from pain in the neck, right arm and hand, that spread to the right scapular and pectoral regions. The pain was most intense in the ulnar portion of the forearm and the third, fourth and fifth fingers. Exercise of all sorts, motion of the neck, coughing and sneezing, and sleeping on the right side aggravated the pain.

Examination disclosed marked weakness of the extensors of the fourth and fifth digits of the right hand, moderately marked weakness of the extensors of the wrist, moderate weakness of the remaining musculature of the forearm, and a slight degree of weakness of the triceps. Atrophy of slight to moderate degree of the forearm was apparent. A slight loss of common sensation could be demonstrated over the ulnar half of the forearm and hand and over the fourth and fifth digits. The triceps reflex was diminished. Pressure on the head led to exaggeration of the pain in the right upper extremity.

Roentgenograms showed loss of the normal cervical lordotic curve with hypertrophic changes along the adjoining borders of the fifth and sixth, and sixth and seventh cervical vertebrae. The hydrodynamics of the cerebrospinal fluid were normal. The total protein content was 70 mg. per 100 cc. Myelographic studies revealed filling defects bilaterally opposite the intervertebral spaces between the fifth and sixth, and the sixth and seventh cervical vertebrae and absence of the nerve sleeve on the right side between the sixth and seventh cervical vertebrae.

At operation the neurosurgeon encountered and removed a hypertrophic spur beneath the sixth cervical nerve root and a protruded nucleus pulposus below the seventh. The operative procedure was followed by immediate relief from the radicular pain in the right upper limb. For ten days there was almost total paralysis of the fourth and fifth digits of the right hand. During the ensuing four days, however, rapid improvement of function took place. At the time of discharge on the 14th postoperative day there was only slight weakness of the musculature of the left arm, forearm, and hand. No change had occurred in the muscular atrophy.

DISCUSSION

The variations in the brachial plexus, which may be prefixed or postfixed, complicate the clinical interpretation of cases of this sort characterized by radicular pain. As a rule, however, weakness of the triceps or a diminished or absent triceps reflex may safely be ascribed to damage to the sixth cervical nerve root. In this instance, the wrist drop was apparently due to involvement of the seventh nerve root.

The alternating exacerbations and remissions of radicular pain and other symptoms and signs offer interesting matter for conjecture. It seems probable that as a result of injury some degree of protrusion of the nucleus pulposus occurs. Flexing or twisting the neck may later push the nuclear mass out, leading to compression of the adjacent nerve root with consequent swelling to the point where the nerve root is actually larger than the corresponding intervertebral foramen. If but one insult of this sort takes place the swelling of the nerve soon subsides and the symptoms disappear. If, however, the nerve is repeatedly injured by protruded material, or by irritation secondary to loss of fluid from the nucleus and consequent trauma to the adjoining structures, the nerve will continue to remain swollen and the symptoms will persist.[7] These postulations may constitute an explanation for the type of relief which frequently follows the use of traction. Obviously surgical treatment alone offers a satisfactory prognosis for cases of this nature and severity.

CONCLUSIONS

Radicular pain in the upper limb has the same general characteristics it exhibits elsewhere. It is limited to the area of distribution of a sensory nerve root, is generally aggravated by coughing and straining, and by reclining for long periods, and is frequently relieved by assuming the upright position. If severe or persistent it may be accompanied by muscular weakness with atrophy and fibrillations due to degeneration of the fibers of the corresponding motor root.

Examples of some of the more common types of syndromes in which radicular pain in the upper extremity is a predominating factor have been presented.

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